CLAIMS

1   1.   A method for reading a license plate disposed on a vehicle, the method

2   comprising:

3   determining whether a license plate image is required;

4   automatically processing the license plate image in response to determining that

5   the license plate image is required;

6   providing at least one verified image; and

7   determining whether to manually read the license plate image by matching the

8   license plate image with the at least one verified image.

1   2.   The method of Claim 1 further comprising manually reading the license plate

2   image.

1   3.   The method of Claim 2 wherein manually reading the license plate image

2   comprises providing a sub-image for reducing license plate image storage.

1   4.   The method of Claim 3 wherein providing a sub-image comprises zooming in on

2   the license plate in the license plate image.

1   5.   The method of Claim 2 wherein manually reading the license plate image

2   comprises:

3   displaying the license plate image to at least three different operators;

4   entering at least three license plate numbers as determined by the least three

5   different operators; and

6   determining if at least two of the at least three determined license plate numbers

7   are identical.

1   6.   The method of Claim 1 wherein matching the license plate image comprises

2   correlating the license plate image with the at least one verified image.

1   7.   The method of Claim 6 further comprising:

2   saving feature data derived from the license plate image; and

3   performing the correlation with the saved feature data.

1   8.   The method of Claim 6 further comprising:

2   providing a match confidence measure; and

3   determining whether the license plate image should be read manually in response

4   to comparing a match confidence measure to a predetermined match threshold.

1   9.   The method of Claim 8 further comprising:

2   manually reading the license plate image in response to the match confidence

3   measure being less than the predetermined match threshold.

1   10.   The method of Claim 1 wherein automatically processing the license plate image

2   comprises using optical character recognition for recognizing a license plate number.

1   11.   The method of Claim 10 further comprising:

2   providing a read confidence measure in response to recognizing the license plate

3   number;

4   comparing the read confidence measure to a predetermined read threshold; and

5   determining in response to the read confidence measure being less than the

6   predetermined read threshold that the license plate image should be read manually.

1   12.   The method of Claim 1 further comprising detecting the vehicle, wherein

2   detecting the vehicle comprises at least one of:

3   reading a transponder disposed on the vehicle;

4   scanning the vehicle with a laser beam; and

5   sensing the vehicle with an induction loop.

1   13.   The method of Claim 1 wherein automatically processing the license plate image

2   comprises matching the license plate image with the at least one verified image.

1   14.   The method of Claim 13 further comprising:

2   saving feature data derived from the license plate image; and

3   performing the correlation with the saved feature data.

1   15.   The method of Claim 1 further comprising updating the at least one verified

2   image.

1   16.   The method of Claim 1 further comprising:

2   determining whether the license plate number associated with the image is a

3   registered plate number; and

4   bypassing manually rereading the license plate image in response to determining

5   that the license plate number associated with the image is a registered plate number.

1   17.   The method of Claim 1 further comprising:

2   manually reading the license plate image for providing a manually read license

3   plate number;

4   automatically reading the license plate image for providing an automatically read

5   license plate number;

6   comparing the manually read license plate number and the automatically read

7   license plate number; and

8   bypassing manually rereading the license plate image in response to determining

9   that the manually read license plate number and the automatically read license plate

10   number are identical.

1   18.   The method of Claim 1 further comprising:

2   providing an automatically read license plate number in response to

3   automatically processing the license plate image ;

4   associating a transponder reading with a transponder registered license plate

5   number;

6   comparing the automatically read license plate number and the transponder

7   registered license plate number; and

8   determining whether to manually read the license plate image in response to

9   determining that the automatically read license plate number and the transponder

10   registered license plate number are identical.

1   19.   The method of Claim 1 further comprising:

2   determining if the license plate image should be discarded; and

3   discarding the license plate image in response to determining the license plate

4   image should be discarded.

1   20.   The method of claim 1 wherein providing at least one verified image comprises:

2   providing at least one stored image of the license plate and a corresponding

3   license plate number;

4   verifying the at least one stored image for providing the at least one verified

5   image.

1   21.   The method of Claim 20 wherein verifying the at least one stored image

2   comprises:

3   manually reading the license plate image for providing a manually read license

4   plate number;

5   associating a transponder reading with a transponder registered license plate

6   number; and

7   determining that the manually read license plate number and the transponder

8   registered license plate number are identical.

1   22.   The method of Claim 20 wherein verifying the at least one stored image

2   comprises:

3   manually reading the license plate image for providing a manually read license

4   plate number;

5   automatically reading the license plate image for providing an automatically read

6   license plate number; and

7   determining that the manually read license plate number and the automatically

8   read license plate number are identical.

1   23.   The method of Claim 20 further comprising adding a new license plate image to a

2   set verified images in response to verifying the image and in response to the set having

3   fewer than the maximum images for the corresponding license plate number.

1 24. The method of Claim 20 further comprising updating the at least one verified

2 image if one of the at least one verified image is replaceable.

1 25. The method of Claim 24 further comprising determining that one of the at least

2 one verified image is replaceable in response to determining that an image quality ratio of

3 the verified images is less than a predetermined threshold and determining that a number

4 of correlation matches included in the image quality ratio is greater than a predetermined

5 sample size.

1 26. The method of Claim 25 wherein the image quality ratio comprises a ratio of a hit

2 count divided by a sum of the hit count and a strike count.

1 27. The method of Claim 26 wherein the hit count includes the number of correlation

2 matches wherein the match confidence measure is greater than or equal to a

3 predetermined match threshold and the license plate image is readable and the manual

4 reads for the license plate image are consistent.

1 28. The method of Claim 26 wherein the strike count includes the number of

2 correlation matches wherein the match confidence measure is less than a predetermined

3 match threshold and the image being processed is readable and all manual reads for the

4 image are consistent.

1 29. The method of claim 1 further comprising:

2 arranging a plurality of roadside toll collectors at intervals along a roadway, each

3 roadside toll collector coupled to at least one of:

4 a traffic probe reader, a toll gateway and an enforcement gateway; for reading a

5 transponder disposed on a vehicle;

6 determining a license plate number corresponding to the transponder reading from

7 the vehicle;

8 comparing the license plate number corresponding to the transponder to the

9 license plate number recognized from the image; and

10 determining in response to the plate number corresponding to the transponder

11 being the same as the license plate number recognized from the image that further

12   identification of the license plate is not required.

1   30.   The method of claim 1 further comprising:

2   combining a plurality of transactions to form a trip; and

3   associating a license plate identification from a first transaction of the trip with a

4   different second transaction for minimizing the number of manual reads.

1   31.   A method for reading a license plate disposed on a vehicle traveling within a toll

2   collection system, the method comprising:

3   providing a first plurality of vehicle detections;

4   determining a second plurality of vehicle detections which potentially form a trip;

5   determining whether the second plurality of vehicle detections includes at least

6   one license plate image; and

7   automatically processing the at least one license plate image.

1   32.   The method of Claim 31 further comprising:

2   manually reading a first one of the plurality of license plate images corresponding

3   to a first one of the second plurality of vehicle detections having an image to verify a

4   corresponding license plate number; and

5   bypassing verification of a second different image corresponding to a second

6   different vehicle detection.

1   33.   The method of claim 31 wherein determining the second plurality of vehicle

2   detections which potentially form a trip comprises using traffic incident data.

1   34.   The method of Claim 31 further comprising:

2   chaining detections to form a potential vehicle trip; and

3   manually verifying the license plate number in response to at least one of:

4   determining that the license plate number does not match a license plate number

5   determined by automatically processing the at least one license plate image;

6   determining that the license plate number is not associated with a transponder;

7   and

8   determining that a device providing the license plate image was operating

9   normally.

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1   35.   The method of Claim 31 further comprising:

2   combining a plurality of detections to form a trip;

3   declaring a final plate read; and

4   billing a corresponding customer for the trip.

1   36.   The method of Claim 31 further comprising verifying reads on single gateway

2   trips.

1   37.   The method of Claim 36 wherein verifying reads on single gateway trips

2   comprises:

3   matching the at least one license plate image with at least one verified image; and

4   determining whether the at least one license plate image matches the least one

5   verified image.

1   38.   A system for reading a vehicle license plate comprising:

2   a plurality of roadside toll collectors providing a plurality of vehicle license plate

3   images and a plurality of vehicle transactions;

4   at least one transaction processor coupled to the plurality of roadside toll

5   collectors, receiving the plurality of images and transactions;

6   at least one video image processor coupled to the at least one transaction

7   processor and adapted to receive the images and for providing a corresponding license

8   plate number;

9   a video exception processor coupled to the at least one transaction processor and

10   adapted to receive the images and to display the images such that the vehicle license plate

11   is read manually; and

12   a toll processor coupled to the at least one transaction processor and adapted to

13   minimize the number of manual reads.

1   39.   The system of Claim 38 wherein the toll processor comprises a trip determination

2   processor.

1   40.   The system of Claim 38 wherein the roadside toll collector is coupled to at least

2   one of:

3   a traffic probe reader;

4   a toll gateway; and

5   an enforcement gateway.

1   41.   The system of Claim 38 further comprising a traffic monitoring and reporting

2   processor.

1   42.   The system of Claim 38 further comprising a real-time enforcement processor.

1   43.   The system of Claim 38 further comprising an image server.

1   44.   The system of Claim 38 wherein the video image processor comprises an OCR

2   processor.

1   45.   The system of Claim 38 wherein the video image processor comprises an image

2   correlation processor.

1   46.   The system of Claim 38 wherein the video exception processor comprises at least

2   one manual plate reading workstation.